

EXHIBIT A

THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

HEADWATER RESEARCH LLC,

Plaintiff,

v.

SAMSUNG ELECTRONIC CO., LTD and
SAMSUNG ELECTRONICS AMERICA, INC.,

Defendants.

Case No. 2:23-CV-00103-JRG-RSP

DEFENDANTS' NOTICE OF SUBPOENA TO GOOGLE LLC

TO ALL PARTIES AND THEIR ATTORNEYS OF RECORD:

PLEASE TAKE NOTICE that pursuant to Rules 30, 34, and 45 of the Federal Rules of Civil Procedure, Defendants Samsung Electronics Co., Ltd. ("SEC") and Samsung Electronics America, Inc. ("SEA") (collectively, "Defendants") have caused or will cause the attached subpoenas to be served on Google LLC ("Google").

Please take further notice that Defendants will require Google to produce the documents, tangible things, and items set out in Attachment A to the subpoena commanding production of documents, to be served on December 1, 2023, a copy of which is attached hereto. The documents, tangible things, and items shall be produced at the place, date, and time specified in the subpoena or another place, date, and time agreed to by the parties.

Please take further notice that Defendants will require Google to present a corporate witness for deposition to speak to the topics identified in Attachment A to the subpoena. The witness shall be present for the deposition at the place, date, and time specified in the subpoena or another place, date, and time agreed to by the parties.

Dated: November 30, 2023

Respectfully submitted,

By: /s/ Grant Schmidt

Grant Schmidt (Texas Bar No. 24084579)

Jon Hyland (Texas Bar No. 24046131)

Theodore Kwong (Texas Bar No. 4087871)

HILGERS GRABEN PLLC

7859 Walnut Hill Lane, Suite 335

Dallas, Texas 75230

Telephone: 469-751-2819

gschmidt@hilgersgraben.com

jhyland@hilgersgraben.com

tkwong@hilgersgraben.com

CERTIFICATE OF SERVICE

I hereby certify on November 30, 2023, a true and correct copy of the foregoing was served on counsel of record for Plaintiff via electronic mail.

/s/ Grant Schmidt
Grant Schmidt

PUBLIC VERSION

AO 88A (Rev. 12/20) Subpoena to Testify at a Deposition in a Civil Action

UNITED STATES DISTRICT COURT

for the

Eastern District of Texas

HEADWATER RESEARCH LLC

Plaintiff

v.

SAMSUNG ELECTRONICS CO., LTD., et al.

Defendant

Civil Action No. 2:23-cv-00103-JRG-RSP

SUBPOENA TO TESTIFY AT A DEPOSITION IN A CIVIL ACTION

To: Google LLC, Registered Agent, Corporation Service Company, 251 Little Falls Drive
Wilmington, DE 19808

(Name of person to whom this subpoena is directed)

☒ **Testimony:** YOU ARE COMMANDED to appear at the time, date, and place set forth below to testify at a deposition to be taken in this civil action. If you are an organization, you must promptly confer in good faith with the party serving this subpoena about the following matters, or those set forth in an attachment, and you must designate one or more officers, directors, or managing agents, or designate other persons who consent to testify on your behalf about these matters: See Attachment A

Place: 300 Delaware Avenue, Suite 815
Wilmington, DE 19801

Date and Time:

12/12/2023 10:00 am

The deposition will be recorded by this method: stenographic means, LiveNote or similar, and/or videotape

☒ **Production:** You, or your representatives, must also bring with you to the deposition the following documents, electronically stored information, or objects, and must permit inspection, copying, testing, or sampling of the material: See Attachment A

The following provisions of Fed. R. Civ. P. 45 are attached – Rule 45(c), relating to the place of compliance; Rule 45(d), relating to your protection as a person subject to a subpoena; and Rule 45(e) and (g), relating to your duty to respond to this subpoena and the potential consequences of not doing so.

Date: 11/29/2023

CLERK OF COURT

OR

/s/ Grant Schmidt

*Signature of Clerk or Deputy Clerk**Attorney's signature*

The name, address, e-mail address, and telephone number of the attorney representing *(name of party)* Defendants
Samsung Electronics Co., Ltd., et al.

, who issues or requests this subpoena, are:
Grant Schmidt, 7859 Walnut Hill Lane, Suite 335, Dallas, TX 75230, gschmidt@hilgersgraben.com, 469-751-2819

Notice to the person who issues or requests this subpoena

If this subpoena commands the production of documents, electronically stored information, or tangible things before trial, a notice and a copy of the subpoena must be served on each party in this case before it is served on the person to whom it is directed. Fed. R. Civ. P. 45(a)(4).

PUBLIC VERSION

AO 88A (Rev. 12/20) Subpoena to Testify at a Deposition in a Civil Action (Page 2)

Civil Action No. 2:23-cv-00103-JRG-RSP

PROOF OF SERVICE*(This section should not be filed with the court unless required by Fed. R. Civ. P. 45.)*

I received this subpoena for *(name of individual and title, if any)* _____
on *(date)* _____ .

☐ I served the subpoena by delivering a copy to the named individual as follows: _____

_____ on *(date)* _____ ; or

☐ I returned the subpoena unexecuted because: _____

Unless the subpoena was issued on behalf of the United States, or one of its officers or agents, I have also
tendered to the witness the fees for one day's attendance, and the mileage allowed by law, in the amount of
\$ _____ .

My fees are \$ _____ for travel and \$ _____ for services, for a total of \$ 0.00 .

I declare under penalty of perjury that this information is true.

Date: _____

Server's signature

Printed name and title

Server's address

Additional information regarding attempted service, etc.:

Print**Save As...****Add Attachment****Reset**

Federal Rule of Civil Procedure 45 (c), (d), (e), and (g) (Effective 12/1/13)

(c) Place of Compliance.

(1) For a Trial, Hearing, or Deposition. A subpoena may command a person to attend a trial, hearing, or deposition only as follows:

- (A) within 100 miles of where the person resides, is employed, or regularly transacts business in person; or
- (B) within the state where the person resides, is employed, or regularly transacts business in person, if the person
 - (i) is a party or a party's officer; or
 - (ii) is commanded to attend a trial and would not incur substantial expense.

(2) For Other Discovery. A subpoena may command:

- (A) production of documents, electronically stored information, or tangible things at a place within 100 miles of where the person resides, is employed, or regularly transacts business in person; and
- (B) inspection of premises at the premises to be inspected.

(d) Protecting a Person Subject to a Subpoena; Enforcement.

(1) Avoiding Undue Burden or Expense; Sanctions. A party or attorney responsible for issuing and serving a subpoena must take reasonable steps to avoid imposing undue burden or expense on a person subject to the subpoena. The court for the district where compliance is required must enforce this duty and impose an appropriate sanction—which may include lost earnings and reasonable attorney's fees—on a party or attorney who fails to comply.

(2) Command to Produce Materials or Permit Inspection.

(A) *Appearance Not Required.* A person commanded to produce documents, electronically stored information, or tangible things, or to permit the inspection of premises, need not appear in person at the place of production or inspection unless also commanded to appear for a deposition, hearing, or trial.

(B) *Objections.* A person commanded to produce documents or tangible things or to permit inspection may serve on the party or attorney designated in the subpoena a written objection to inspecting, copying, testing, or sampling any or all of the materials or to inspecting the premises—or to producing electronically stored information in the form or forms requested. The objection must be served before the earlier of the time specified for compliance or 14 days after the subpoena is served. If an objection is made, the following rules apply:

- (i) At any time, on notice to the commanded person, the serving party may move the court for the district where compliance is required for an order compelling production or inspection.
- (ii) These acts may be required only as directed in the order, and the order must protect a person who is neither a party nor a party's officer from significant expense resulting from compliance.

(3) Quashing or Modifying a Subpoena.

(A) *When Required.* On timely motion, the court for the district where compliance is required must quash or modify a subpoena that:

- (i) fails to allow a reasonable time to comply;
- (ii) requires a person to comply beyond the geographical limits specified in Rule 45(c);
- (iii) requires disclosure of privileged or other protected matter, if no exception or waiver applies; or
- (iv) subjects a person to undue burden.

(B) *When Permitted.* To protect a person subject to or affected by a subpoena, the court for the district where compliance is required may, on motion, quash or modify the subpoena if it requires:

(i) disclosing a trade secret or other confidential research, development, or commercial information; or

(ii) disclosing an unretained expert's opinion or information that does not describe specific occurrences in dispute and results from the expert's study that was not requested by a party.

(C) *Specifying Conditions as an Alternative.* In the circumstances described in Rule 45(d)(3)(B), the court may, instead of quashing or modifying a subpoena, order appearance or production under specified conditions if the serving party:

- (i) shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship; and
- (ii) ensures that the subpoenaed person will be reasonably compensated.

(e) Duties in Responding to a Subpoena.

(1) Producing Documents or Electronically Stored Information. These procedures apply to producing documents or electronically stored information:

(A) *Documents.* A person responding to a subpoena to produce documents must produce them as they are kept in the ordinary course of business or must organize and label them to correspond to the categories in the demand.

(B) *Form for Producing Electronically Stored Information Not Specified.* If a subpoena does not specify a form for producing electronically stored information, the person responding must produce it in a form or forms in which it is ordinarily maintained or in a reasonably usable form or forms.

(C) *Electronically Stored Information Produced in Only One Form.* The person responding need not produce the same electronically stored information in more than one form.

(D) *Inaccessible Electronically Stored Information.* The person responding need not provide discovery of electronically stored information from sources that the person identifies as not reasonably accessible because of undue burden or cost. On motion to compel discovery or for a protective order, the person responding must show that the information is not reasonably accessible because of undue burden or cost. If that showing is made, the court may nonetheless order discovery from such sources if the requesting party shows good cause, considering the limitations of Rule 26(b)(2)(C). The court may specify conditions for the discovery.

(2) Claiming Privilege or Protection.

(A) *Information Withheld.* A person withholding subpoenaed information under a claim that it is privileged or subject to protection as trial-preparation material must:

- (i) expressly make the claim; and
- (ii) describe the nature of the withheld documents, communications, or tangible things in a manner that, without revealing information itself privileged or protected, will enable the parties to assess the claim.

(B) *Information Produced.* If information produced in response to a subpoena is subject to a claim of privilege or of protection as trial-preparation material, the person making the claim may notify any party that received the information of the claim and the basis for it. After being notified, a party must promptly return, sequester, or destroy the specified information and any copies it has; must not use or disclose the information until the claim is resolved; must take reasonable steps to retrieve the information if the party disclosed it before being notified; and may promptly present the information under seal to the court for the district where compliance is required for a determination of the claim. The person who produced the information must preserve the information until the claim is resolved.

(g) Contempt.

The court for the district where compliance is required—and also, after a motion is transferred, the issuing court—may hold in contempt a person who, having been served, fails without adequate excuse to obey the subpoena or an order related to it.

ATTACHMENT A

The following definitions and instructions apply.

DEFINITIONS

1. “You,” “Your,” and “Google LLC” mean Google LLC, and its officers, directors, current and former employees, counsel, agents, consultants, representatives, and any other persons acting on behalf of any of the foregoing, and all Google affiliates, parents, divisions, joint ventures, licensees, franchisees, assigns, predecessors and successors in interest, and any other legal entities, whether foreign or domestic, that are owned, controlled by, or under common control with Google and all predecessors and successors in interest to such entities.

2. “Headwater” means Headwater Research, LLC, and its officers, directors, current and former employees, counsel, agents, consultants, representatives, and any other persons acting on behalf of any of the foregoing, and all Headwater affiliates, parents, divisions, joint ventures, licensees, franchisees, assigns, predecessors and successors in interest, and any other legal entities, whether foreign or domestic, that are owned, controlled by, or under common control with Headwater and all predecessors and successors in interest to such entities.

3. “Asserted Patents” means United States Patent Nos. 8,406,733 (“the ’733 patent”), 9,198,117 (“the ’117 patent”), and 9,615,192 (“the ’192 patent”).

4. “Document” and “Documents” shall be interpreted in their broadest possible sense and, at a minimum, shall be synonymous in meaning and equal in scope to usage of the term in Rule 34(a)(1)(A) of the Federal Rules of Civil Procedure and means any writing of any kind, including originals and all non-identical copies (whether different from the originals by reason of any notation made on such copies or otherwise), including any medium in which information is stored, by Rule 1001 of the Federal Rules of Evidence, including without limitation Electronically Stored Information. If a draft Document has been prepared in several copies that are not identical, or if the original identical copies are no longer identical due to subsequent notation, each non-identical Document is a separate Document.

5. “Thing(s)” is used in the broadest sense to include everything contemplated by Rule 34(a)(1)(B) of the Federal Rules of Civil Procedure.

6. “Person” or “Entity” and their plural forms include, without limitation, natural persons, law firms, partnerships, corporations, associations, and any other legal entities and divisions, departments, or other units thereof.

7. “Communication” means any transmission of information, including drafts.

8. “And” shall be treated as a synonym for “or” and vice versa. “Any” and “each” shall be understood to include one another and “all” whenever necessary to expand the scope of the request. The words “all,” “every,” “any,” and “each” shall include each other whenever possible to expand the scope of the request.

9. “Message Delivery” refers to functionality that You developed involving sending messages from servers to apps on devices with Android, including the “p2p messaging passing system” feature mentioned in *P2P Service Using XMPP* (Exhibit A¹) and related functionalities implemented at least in Android versions m3-rc20a, m3-rc22a, m3-rc37a, and m5-rc14 (Exhibit B²) and the “Push sync” feature mentioned on Slide 9 of the May 20, 2010 *Building Push Applications for Android* presentation (attached as Exhibit C³).

10. In construing these definitions and instructions: (i) the singular shall include the plural and the plural shall include the singular; (ii) the masculine, feminine or neuter pronoun shall not exclude the other genders; (iii) the conjunctions “and” and “or” shall be read either disjunctively or conjunctively so as to bring within the scope of each topic all information that might otherwise be construed to be outside its scope; and (iv) the word “any” shall be read to mean each and every.

¹ Attached as Exhibit A and available at <https://web.archive.org/web/20071203160805/http://code.google.com/android/toolbox/google-apis.html>

² Attached as Exhibit B and available at https://developer.android.com/sdk/older_releases

³ Attached as Exhibit C and available at <https://docs.huihoo.com/google/io/2010/android-push-applications-android.pdf>

INSTRUCTIONS

1. Accompanying any document production, you shall provide a written declaration from the custodian or other qualified person certifying that the respective document production identified by Bates range, was: (A) made at or near the time of the occurrence of the matters set forth by, or from information transmitted by, a person with knowledge of those matters; (B) kept in the course of the regularly conducted activity; and (C) made by the regularly conducted activity as a regular practice.

2. These requests shall apply to all items (e.g., documents or things) in your possession, custody, or control and/or the possession, custody, or control of any of your employees, agents, corporations, parent or subsidiary corporations, and/or divisions or affiliates.

3. If no documents are responsive to a particular request, state that no responsive documents exist.

4. If You claim that a Request for Production is over-broad or unduly burdensome, please respond to that portion of the Request for Production to which You do not object and specifically state why You claim the Request for Production is over-broad or unduly burdensome.

5. All documents requested are to be produced in the same file or other organizational environment in which they are maintained. For example, a document that is part of a file, docket, or other grouping, should be physically produced together with all other documents from said file, docket or grouping, in the same order or manner of arrangement as the original.

6. A copy of the Stipulated Protective Order entered in this case is included herewith. Thus, pursuant to the Protective Order adopted by the Court in this case, if You deem any document or information produced to be confidential, designate the document pursuant to the Protective Order.

REQUESTS FOR PRODUCTION

REQUEST FOR PRODUCTION NO. 1:

Documents sufficient to show research, development, design, and use of “message delivery,” including any predecessor to Cloud to Device Messaging, prior to September 15, 2009 (and particularly prior to January 28, 2008).

REQUEST FOR PRODUCTION NO. 2:

Documents sufficient to show the identity, sale, offers for sale, public use and/or public demonstration of “message delivery,” including any predecessor to Cloud to Device Messaging, prior to September 15, 2009 (and particularly prior to January 28, 2008) or the earliest date thereafter, including the earliest sale, offer for sale, public use, or public demonstration of push sync.

TOPICS FOR DEPOSITION

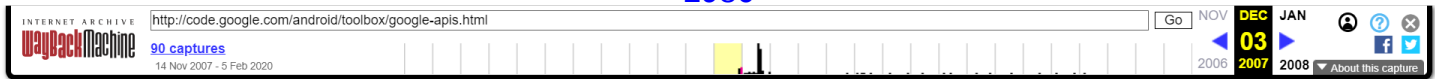
TOPIC NO. 1:

The research, development, design, and use of “message delivery,” including any predecessor to Cloud to Device Messaging, prior to September 15, 2009.

TOPIC NO. 2:

The identify, sale, offers for sale, public use and/or public demonstration of “message delivery,” including any predecessor to Cloud to Device Messaging, prior to September 15, 2009 or the earliest date thereafter.

EXHIBIT A



e.g. "intent" or "activity"

[Site Directory](#)

Android - An Open Handset Alliance Project

[Home](#) [Docs](#) [FAQ](#) [Blog](#) [Group](#) [Terms](#)

Documentation

- [What is Android?](#)
- [Getting Started](#)
- [Developing Applications](#)
- [Developer Toolbox](#)
- [Reference Information](#)
- [Sample Code](#)
- [FAQs](#)

Goodies

Google APIs and Services in Android

Since Android is an open cell phone platform, anyone will be able to build their own devices that run the core Android OS. There is no requirement that any given phone include any Google software, or even be associated with Google at all.

However, some groups may choose to license a set of optional user applications from Google that provide convenient developer access to Google services. This will generally be a collection of software included in the base system image and shipped with the phone.

Because many devices will include these libraries, for the convenience of developers we're including information about those APIs here. However, please be aware that any APIs you use from the list below may not be available on all Android devices. If the Google software is not present, these libraries and classes will not be present. As a result, if your application uses these APIs, it may not install or run properly on devices that lack the APIs.

MapView

The [MapView](#) is an Android View that allows third-party code to display and control a Google Map. This is a complementary offering to the [MapActivity](#) provided in the Google Maps application that other Activities can use to display maps of a specific location. The table below summarizes the differences between the two approaches.

Feature	MapActivity	MapView
Embeddable directly into your own Layout?	No (can only set map display)	Yes
User-controlled navigation?	Yes	Yes
Navigation via code? (i.e. scroll, zoom, etc. from your application code)	No	Yes
Can fire events into your own code?	No	Yes

The advantage of using the MapView over the Activity is that it gives you tight integration with your own layout; for instance, you can wrap custom controls around it, or implement fancy input mechanisms (such as using a tilt-sensor to scroll the Map based on how the user tilts the device). The disadvantage of using the MapView is that it requires more code to set up and use; if you simply wish to display a Google Map with the standard UI, it will be much easier to use the Activity.

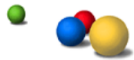
P2P Services Using XMPP

Applications will frequently need to communicate between devices. For instance, you might wish to send messages back and forth between two devices, to implement an interactive game of checkers. Or, you might develop a social application where you want to send a message to a buddy.

One way to do this is to simply send an SMS message to the other phone. It's possible to receive notifications via an [IntentReceiver](#) of incoming SMS messages, inspect them to see if they contain data intended for your application, and then consume the message, preventing other applications (and the user) from ever seeing it directly. This works well, but it has two major down-sides: SMS messages can take several minutes to deliver, and they typically cost users money to send and receive. If you built an online game using SMS message-passing, it might very well be both slow and frustrating, and very expensive to your users.

As an alternative, Google provides an [API that uses the XMPP protocol to pass messages](#). XMPP includes presence notification, meaning that it provides a convenient way for phones to notify each other when they are online and available for message-passing. It also provides a programmatic model similar to SMS-based message-passing, in that the sender calls a method on a Service to send a message, and the receiver is notified via a broadcast Intent (which it can fetch via an [IntentReceiver](#)). However, because XMPP is a persistent socket connection, the response time is much faster than SMS, allowing for a more fluid user experience.

The system currently maintains a single XMPP connection to the server, and all XMPP traffic — including both standard XMPP instant messages, and this P2P message-passing system — is carried on the same connection.





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Build m3-rc27 - 21 Nov 2007 18:13

EXHIBIT B

Android Developers

Was this helpful?  

SDK Archives

This page provides archived and obsolete versions of the Android SDK, including non-current versions of active releases and "early look" versions that were released before Android 1.0.

These are provided for informational and archival purposes only. You should instead [download the latest version of Android Studio](#), through which you can download previous versions of the Android platform for app development.

Archived SDKs

The tables below provides Android SDKs that are current in terms of their platform version, but do not provide the latest Android development environment and tools. You should instead download each version of the Android platform with [Android Studio's SDK Manager](#).

Release 1.6 r1

September 2009 - [Release Notes](#)

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.6_r1.zip	260529085 bytes	2bcbacbc7af0363058ca1cac6abad848
Mac OS X (intel)	android-sdk-mac_x86-1.6_r1.zip	247412515 bytes	eb13cc79602d492e89103efcf48ac1f6
Linux (i386)	android-sdk-linux_x86-1.6_r1.tgz	238224860 bytes	b4bf0e610ff6db2fb6fb09c49cba1e79

Release 1.5 r3

July 2009 - [Release Notes](#)

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.5_r3.zip	191477853 bytes	1725fd6963ce69102ba7192568dfc711
Mac OS X (intel)	android-sdk-mac_x86-1.5_r3.zip	183024673 bytes	b1bafdaefdcec89a14b604b504e7daec
Linux (i386)	android-sdk-linux_x86-1.5_r3.zip	178117561 bytes	350d0211678ced38da926b8c9ffa4fac

Release 1.1 r1

February 2009 - [Release Notes](#)

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.1_r1.zip	86038515 bytes	8c4b9080b430025370689e03d20842f3

On this page

Archived SDKs

- Release 1.6 r1
- Release 1.5 r3
- Release 1.1 r1
- Release 1.0 r2

Obsolete SDK Releases

- Release 1.5 r2
- Release 1.5 r1
- Release 1.0 r1

Non-Compatible SDK Releases

PUBLIC VERSION

Mac OS X (intel)	android-sdk-mac_x86-1.1_r1.zip	79046151 bytes	becf0f1763d61eedce15d2a903d6c1dd
Linux (i386)	android-sdk-linux_x86-1.1_r1.zip	79345522 bytes	ebcb16b0cd4aef198b4dd9a1418efbf1

Release 1.0 r2

November 2008 - [Release Notes](#)

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.0_r2.zip	98360564 bytes	a5e1af8ac145946b4a9627516ad4a711
Mac OS X (intel)	android-sdk-mac_x86-1.0_r2.zip	93771410 bytes	87b99d5e9f59b78363a63200c11498e8
Linux (i386)	android-sdk-linux_x86-1.0_r2.zip	94186463 bytes	a1f3b6d854596f850f5008856d0f380e

Obsolete SDK Releases

These tables provide Android SDK releases that have been superseded by an active release (shown above) and that are now obsolete.

Release 1.5 r2

May 2009 - [Release Notes](#)

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.5_r2.zip	178346828 bytes	ba54ac6bda45921d442b74b6de6ff6a9
Mac OS X (intel)	android-sdk-mac_x86-1.5_r2.zip	169945128 bytes	f4e06a5194410243f213d0177713d6c9
Linux (i386)	android-sdk-linux_x86-1.5_r2.zip	165035130 bytes	1d3c3d099e95a31c43a7b3e6ae307ed3

Release 1.5 r1

April 2009 - [Release Notes](#)

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.5_r1.zip	176263368 bytes	42be980eb2d3efaced01ea6c32c0045f
Mac OS X (intel)	android-sdk-mac_x86-1.5_r1.zip	167848675 bytes	5b2a8d9f096032db4a75bfa0d689a51b
Linux (i386)	android-sdk-linux_x86-1.5_r1.zip	162938845 bytes	2addfd315da0ad8b5bde6b09d5ff3b06

Release 1.0 r1

September 23, 2008 - [Release Notes](#)

PUBLIC VERSION

Platform	Package	Size	MD5 Checksum
Windows	android-sdk-windows-1.0_r1.zip	89.7 MB bytes	d69f4ee93d4010f726c04302662fd999
Mac OS X (intel)	android-sdk-mac_x86-1.0_r1.zip	87.5 MB bytes	564876ada22872e50c2866806de9fc5c
Linux (i386)	android-sdk-linux_x86-1.0_r1.zip	87.8 MB bytes	2660b4029039b7d714e59827e9a9a11d

Non-Compatible SDK Releases

The SDKs listed below are "early-look" versions that were released in the year preceding the full release of Android 1.0 in September 2008. Because these early-look SDKs were released before the Android 1.0 API specification was finalized, they do not provide a compliant Android execution environment. Consequently, applications that you develop in these SDKs will not be able to run on any Android-powered devices.

If you have an older application that you built in one of the early-look SDKs, you must migrate it to the Android 1.0 SDK (or later release) before you will be able to deploy it to an Android-powered device. To help with this migration, each SDK package below provides information about API changes from the previous version. You can find the migration information in the documentation included in each SDK package.

Version 0.9 Beta

August 18, 2008 - [Release Notes](#)

Package	Size	MD5 Checksum
Windows android-sdk-windows-0.9_beta.zip	93,126,573 bytes	305031ad8335d1b6040bdd5a65349d6d
Mac OS X (intel) android-sdk-mac_x86-0.9_beta.zip	91,374,464 bytes	9a6969159091ced46302e11049fe3ca
Linux (i386) android-sdk-linux_x86-0.9_beta.zip	91,821,068 bytes	077e5ef549dd9c5be54bd88e6a8e196c

Version m5-rc15

March 3, 2008 - [Release Notes](#)

Package	Size	MD5 Checksum
Windows android-sdk_m5-rc15_windows.zip	79 MB	ecce40bc50201886d95ba2690cdb5ce
Mac OS X (intel) android-sdk_m5-rc15_mac-x86.zip	76 MB	45a6385bbc1b2cb295409cfc81fb04b4
Linux (i386) android-sdk_m5-rc15_linux-x86.zip	76 MB	e913f785afecdeed34c30639fd8c5862

Version m5-rc14

February 12, 2008 - [Release Notes](#)

Package	Size	MD5 Checksum
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PUBLIC VERSION

Windows	android-sdk_m5-rc14_windows.zip	79 MB	ecc75c1e69588350634ca25867ce05a0
Mac OS X (intel)	android-sdk_m5-rc14_windows.zip	76 MB	844c80d0adb1a326f5a9fff262c61efc
Linux (i386)	android-sdk_m5-rc14_linux-x86.zip	76 MB	f8b863c8a880afe9bb84124f5976aab1

Version m3-rc37a

December 14, 2007 - [Release Notes](#)

Package		Size	MD5 Checksum
Windows	android_sdk_windows_m3-rc37a.zip	58 MB	5db5aea20a2c2f010baefc4b1091a575
Mac OS X (intel)	android_sdk_darwin_m3-rc37a.zip	54 MB	0b22e73fbd07b4af4009387afce3a37f
Linux (i386)	android_sdk_linux_m3-rc37a.zip	54 MB	41285beecc4f9926e6ecf5f12610b356

Version m3-rc22a

November 16, 2007 - [Release Notes](#)

Package		Size	MD5 Checksum
Windows	android_sdk_windows_m3-rc22a.zip	59 MB	aa3dee05a9872752a3bc4efd0f93e98b
Mac OS X (intel)	android_sdk_darwin_m3-rc22a.zip	55 MB	0547f45614ad94c3af22c3c0aa6f709f
Linux (i386)	android_sdk_linux_m3-rc22a.zip	55 MB	84b3455de5cdfd841a172c13d24c382e

Version m3-rc20a

November 12, 2007 - [Release Notes](#)

Package		Size	MD5 Checksum
Windows	android_sdk_windows_m3-rc20a.zip	59 MB	a404b875708df7339ba77bdf2e08dc06
Mac OS X (intel)	android_sdk_darwin_m3-rc20a.zip	55 MB	8fc29aeaa45eda84bfac854ebd02a6da
Linux (i386)	android_sdk_linux_m3-rc20a.zip	55 MB	9196759df9b69cd89a220b156f133364

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EXHIBIT C

PUBLIC VERSION



Building Push Applications for Android

Debajit Ghosh
May 20, 2010



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Outline

- Accessing Data in the Cloud
- Polling and Pushing
- Android Cloud to Device Messaging
- Demos
- Summary

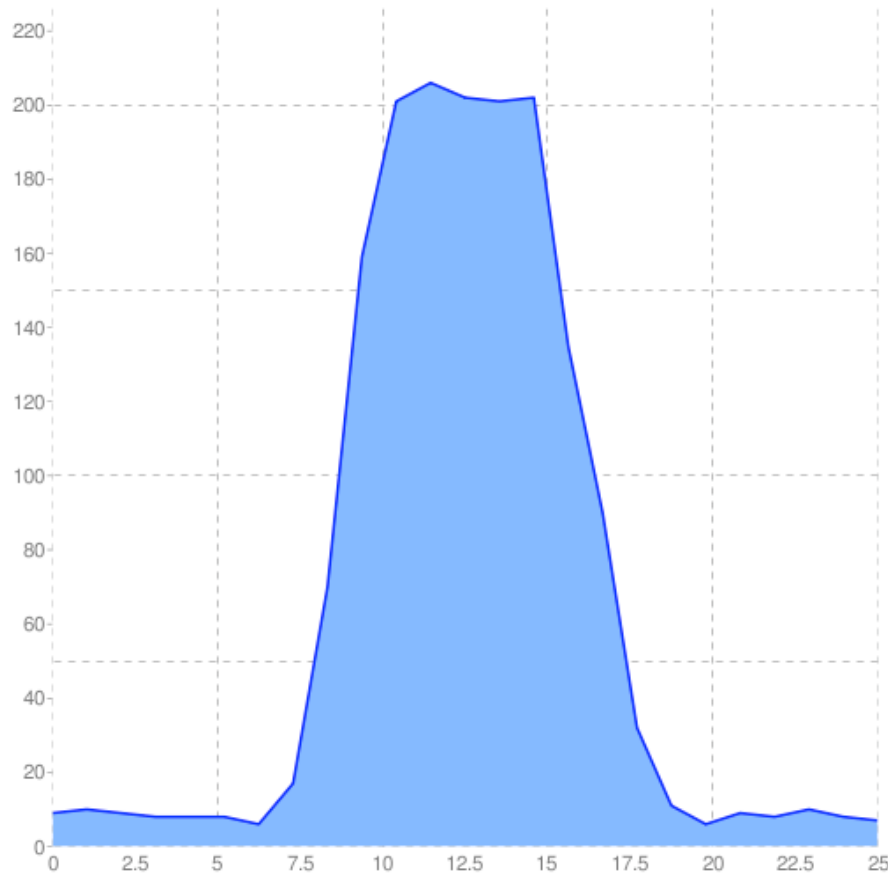
Accessing Data in the Cloud

- Apps provide seamless access to data in the cloud
 - Mobile Alerts
 - Send to Phone
 - Background Sync
- Challenge: How do you keep data on a device fresh?

Polling

- Simple to implement
- Device periodically asks server for new data
 - Radio draws a lot of power, stays on for several seconds
 - Ideally, use If-Modified-Since, If-None-Match, etc.
 - Make no-ops as cheap as possible
- Appropriate for content that changes constantly
 - Stock Quotes, News Headlines
 - Poll infrequently, update on demand

Impact of Polling on Battery



- Baseline: ~5-8 mA
- Network: ~180-200 mA
 - Tx more expensive than Rx
- Radio stays on for few secs
- ~0.50 mAh for a short poll
 - 5m frequency: ~144 mAh / day
 - 15m frequency: ~48 mAh / day

Source: Android development team at Google

When to Poll?

- Tradeoff between freshness and efficiency
 - Poll frequently – more fresh, less efficient
- Desire: *Push*, don't poll
 - Only fetch data when useful

Pushing

- Enables freshness with less impact on battery
 - Only use network when necessary
 - Constant overhead of persistent connection
- Google Contacts, Calendar, Gmail, etc., use push sync
- Can be tricky to implement
- Android Cloud to Device Messaging makes push easy

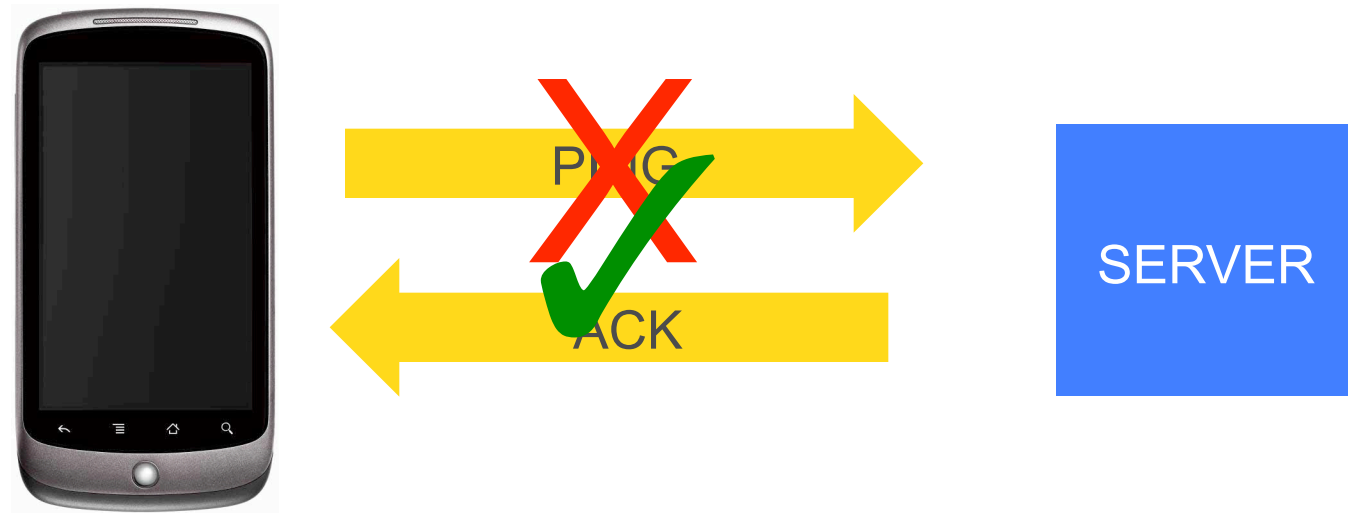
Android Cloud to Device Messaging

- Simple Google API
 - Android 2.2 devices with Market
 - Will be open to all developers
- Uses existing connection for Google services
- Allows servers to send lightweight “data” messages to apps
 - Tell app new data available
 - Intent broadcast wakes up app
 - App supplies UI, e.g., Notification, if/as necessary
- Best effort delivery

Peeking Under the Hood

- Background service
 - Honor background data setting
 - Start when network available
- Maintain connection with server
 - Use heartbeats to keep alive, detect dead connections
- Efficient
 - Minimize per connect overhead
 - Minimize heartbeat frequency
 - Minimize concurrent connections

Heartbeats

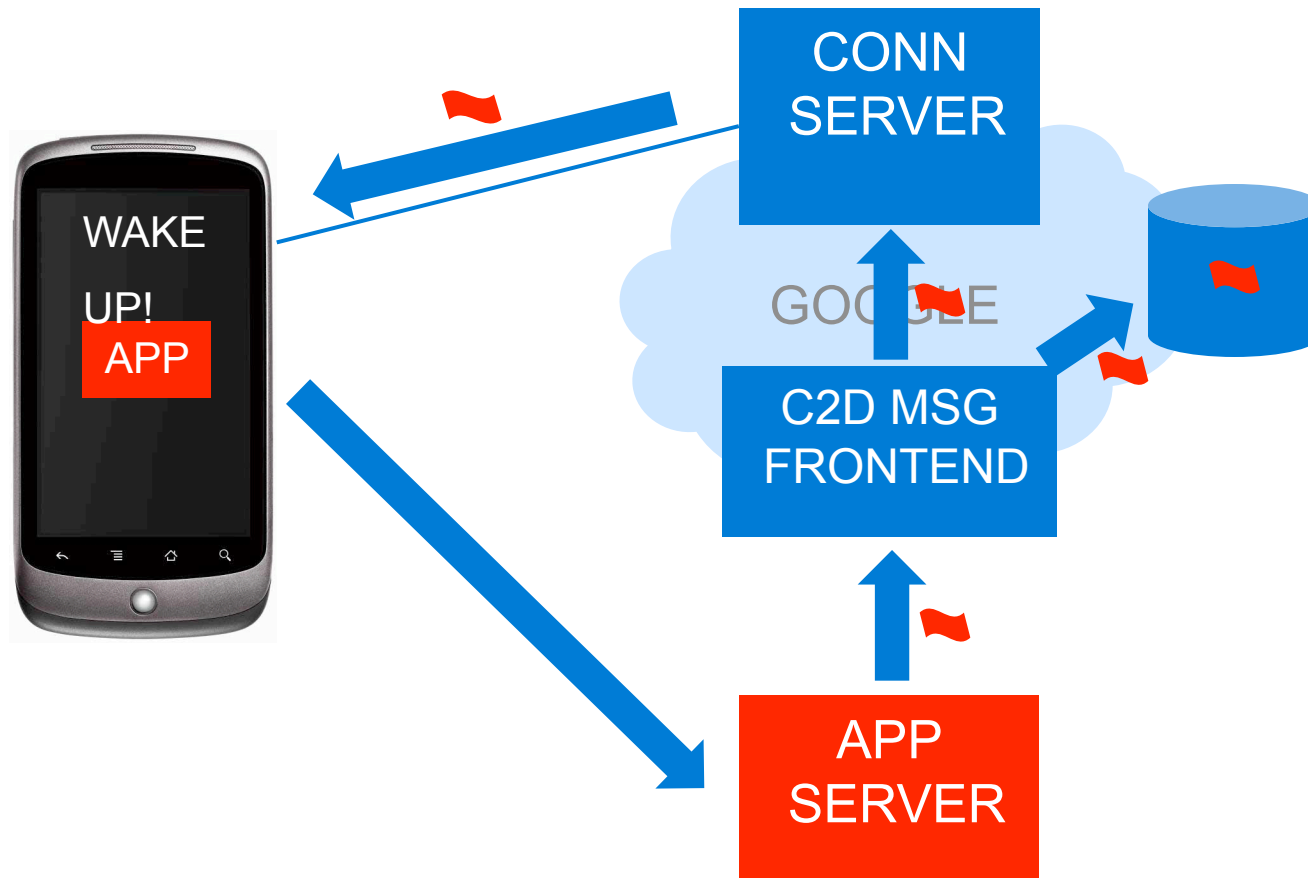


- Use Alarms
 - (Re)schedule pings
 - Wait for acks
- Reconnect when dead
- Can also initiate ping
 - May be half open
- Clean up state when dead

Overview of Lifecycle

- Enabling cloud to device messaging
 - App (on device) registers with Google, gets registration ID
 - App sends registration ID to its App Server
- Per message
 - App Server sends (authenticated) message to Google
 - Google sends message to device
- Disabling cloud to device messaging
 - App can unregister ID, e.g., when user no longer wants push

Life of a Message



Registration – Requesting a Registration ID

```
// Use the Intent API to get a registration ID  
// Registration ID is compartmentalized per app/device  
Intent regIntent = new  
    Intent("com.google.android.c2dm.intent.REGISTER");  
// Identify your app  
regIntent.putExtra("app",  
    PendingIntent.getBroadcast(this, 0, new Intent(), 0);  
// Identify role account server will use to send  
regIntent.putExtra("sender", emailOfSender);  
// Start the registration process  
startService(regIntent);
```

Registration – Receiving the Registration ID

- App receives the ID as an Intent
 - `com.google.android.c2dm.intent.REGISTRATION`
- App should send this ID to its server
- Service may issue new registration ID at any time
 - App will receive REGISTRATION Intent broadcast
 - App must update server with new ID

Registration – Receiving the Registration ID

```
// Registration ID received via an Intent

public void onReceive(Context context, Intent intent) {
    String action = intent.getAction();
    if ("...REGISTRATION".equals(action)) {
        handleRegistration(context, intent);
    }
}

private void handleRegistration(Context context, Intent intent){
    String id = intent.getStringExtra("registration_id");
    if ((intent.getStringExtra("error") != null) {
        // Registration failed. Try again later, with backoff.
    } else if (id != null) {
        // Send the registration ID to the app's server.
        // Be sure to do this in a separate thread.
    }
}
```

Sending Messages

- Get “ac2dm” auth token, install on server
 - <http://code.google.com/apis/accounts/docs/AuthForInstalledApps.html>
- Send authenticated POST
 - <https://android.apis.google.com/c2dm/send>
 - Authorization: GoogleLogin auth=<auth token>
 - URL Encoded parameters
 - registration_id
 - collapse_key
 - (optional) delay_while_idle
 - (optional) data.<key>*

Sending Messages – Response Codes

- 200 OK
 - With “id” – request succeeded, message enqueued
 - With “Error” – request failed
 - QuotaExceeded, DeviceQuotaExceeded: Retry after a while
 - InvalidRegistration, NotRegistered: Stop sending messages
 - MessageTooBig: Reduce size of message
 - MissingCollapseKey: Include collapse key in request
- 401 Not Authorized: Get new auth token
- 503 Service Unavailable: Retry with backoff

Receiving Messages

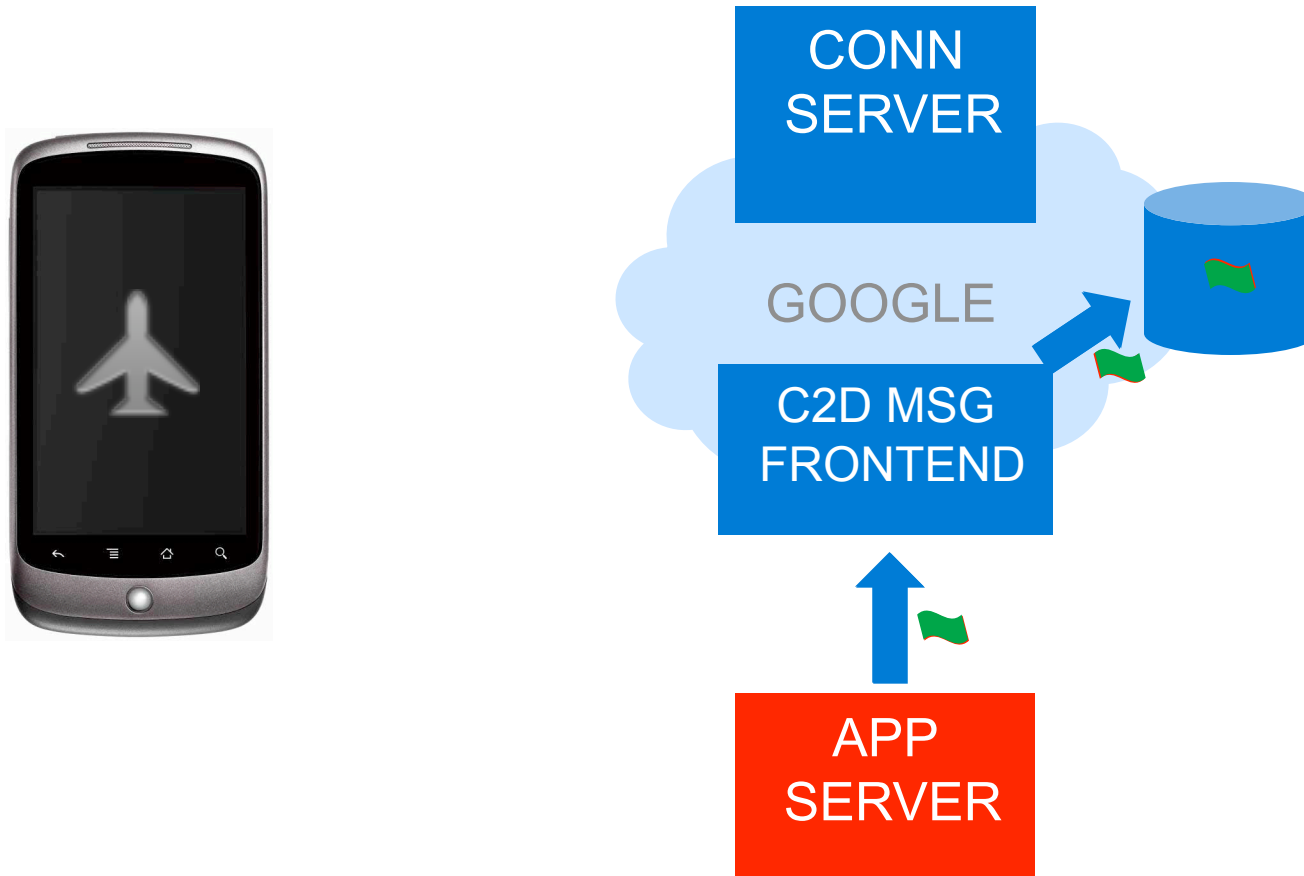
- Device receives message, converts to Intent
- App woken up/started by Intent broadcast
 - `com.google.android.c2dm.intent.RECEIVE`
 - `data.<key>*` set as Intent extras
 - App needs `com.example.app.permission.C2D_MESSAGE`

```
public void onReceive(Context context, Intent intent) {  
    String action = intent.getAction();  
    if ("...RECEIVE".equals(action)) {  
        // Grab a wakelock, use IntentService to do work  
    }  
}
```

Collapse Keys

- Latest message replaces older ones with same key
- Avoids message explosion for offline device
- App may use multiple collapse keys
 - Correspond to “feed” app will fetch
 - Max of four in flight (per device)
- State should be in app server, not in message
 - Tell app when it should fetch data

Collapse Keys

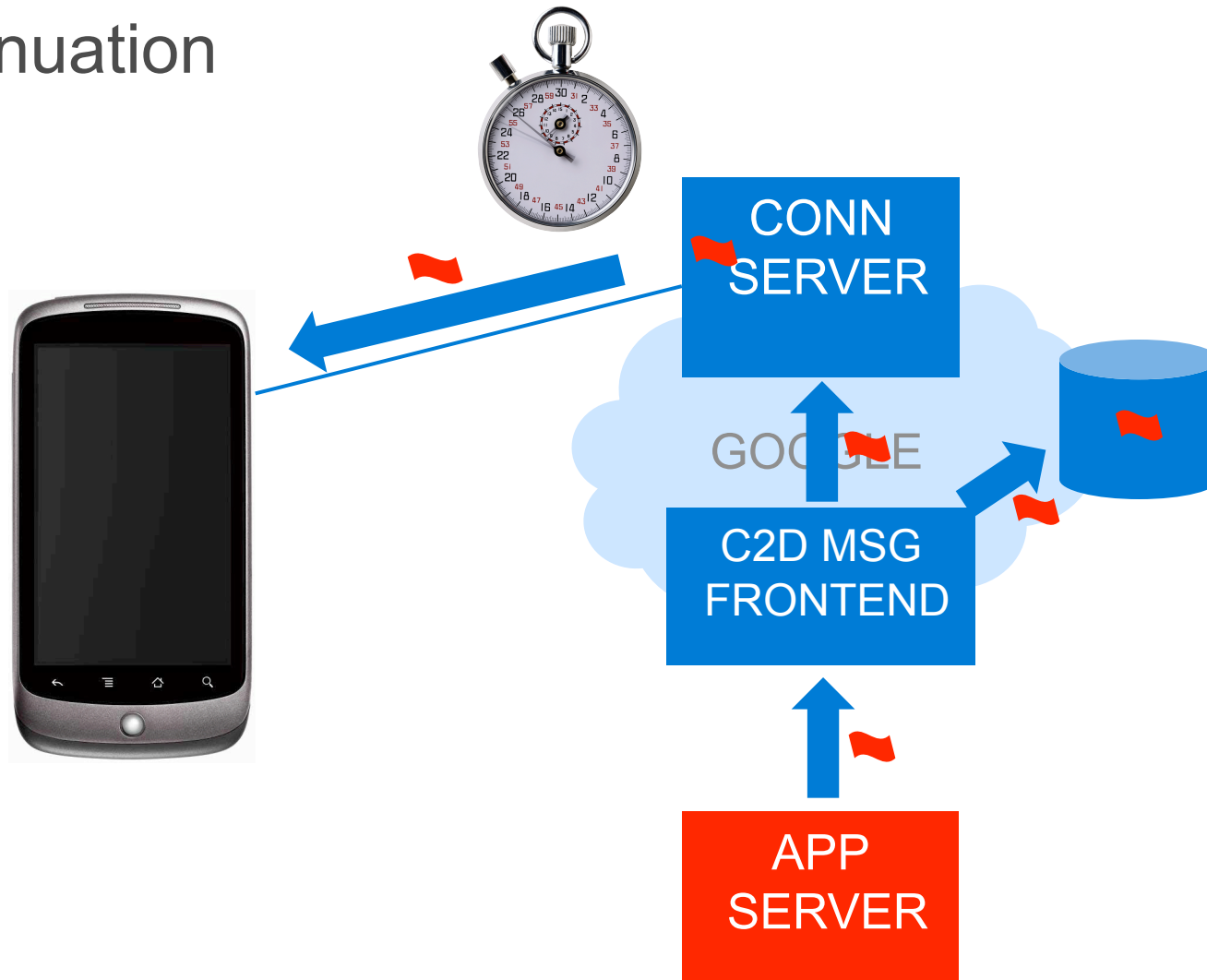


Attenuation

- Messages may not be delivered to device immediately
- Protects devices that are receiving many messages
 - Avoid constant radio wakeup
- Attenuation per app/collapse key

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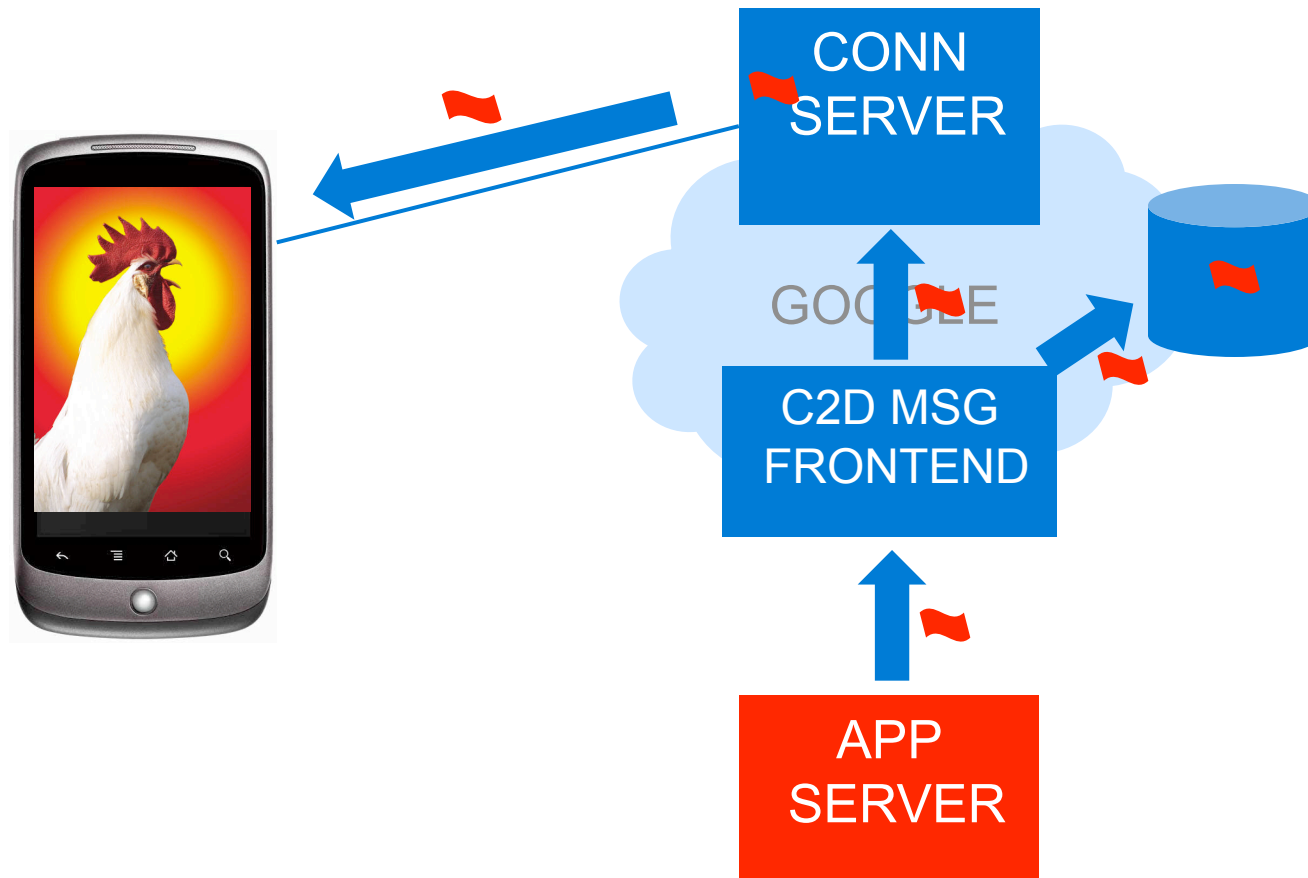
Attenuation



Delay While Idle

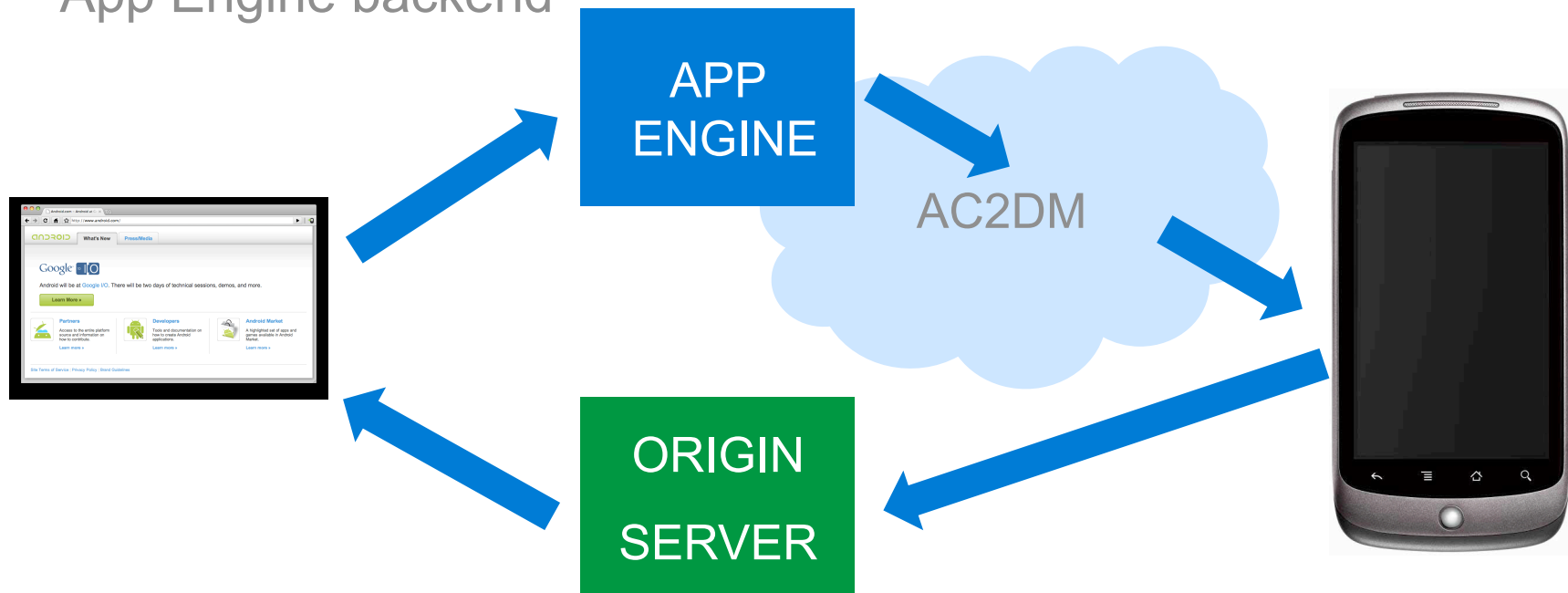
- Device tells Connection Server when screen is on, off
 - Screen off == device is idle
- Apps can request message only be delivered when active
 - Avoid waking up device with info that will not be seen/used
 - e.g., chat presence, friend location updates

Delay While Idle



Demo: Google Chrome to Phone Extension

- Send any web page to Android device
 - Special handling for Maps, YouTube
- Chrome Extension
- App Engine backend



Demo: JumpNote

- Notes, with two way push sync
 - App Engine backend, GWT UI
- Uses Sync Framework
- Uses Android Cloud to Device Messaging
 - Register, Unregister based on auto-sync selection

```
public void onReceive(Context context, Intent intent) {  
    String action = intent.getAction();  
    if ("...RECEIVE".equals(action)) {  
        // Determine account, feed that changed ...  
        context.getContentResolver.requestSync(account, "...jumpnote", extras);  
    }  
}
```

Android Cloud to Device Messaging Signup

- Launching in Labs, accepting signups
- Visit <http://code.google.com/android/c2dm> for details

Summary

- Many Android apps access data in cloud
- Push keeps apps up to date, efficiently
- Android Cloud to Device Messaging makes push simple
- Sign up now
 - <http://code.google.com/android/c2dm>

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